

## UV Curable Coatings for Wood Meet Manufacturer's Challenges

### The Challenge: Reduce Emissions and Improve Quality of Wood Moldings

E&J Industries of Woodridge, New York, manufactures a wide assortment of wood moldings, including brush blocks (the portion of a brush to which the bristles are attached) and tool grips, such as mop and broom handles. The company processes several million feet of oak, ash, pine, and fir every year, much of which requires some type of protective or decorative finish. The stains, paints, and lacquers traditionally used to finish these products contain significant amounts of solvents (volatile organic compounds (VOCs)) and, frequently, hazardous air pollutants (HAPs). VOCs and HAPs are monitored by federal and state agencies and, in most cases, must be drastically reduced or totally eliminated in order for a company to be in compliance with the Clean Air Act.

Ed Kossar, President and CEO of E&J, stated, "Our previous finishes were mostly lacquer based materials that contained methyl ethyl ketone and toluene. Both of those materials are considered to be VOCs and both are listed as HAPs. Our goals were to reduce the emission of VOCs and HAPs from our plant, provide a safer workplace for our employees, and improve the quality of our products."

### The Conventional Way

E&J utilized a gasket dipping method to apply lacquers to dowel stock used for broom and mop handles, and used a spray application for other molded products. All coatings were air-dried at ambient plant temperatures.

The gasket dipping method was a semiautomated process by which products were loaded into a feed hopper that fed them to a conveyor. The conveyor transported the dowels to the coating chamber where the paint was applied, and then through a gasket that removed

the excess coating. The products continued on the conveyor for air drying.

Depending on the temperature and humidity, the total time for the process was 10 to 20 minutes.

The spray application method was entirely manual. Products had to be placed on racks to be painted, allowed to air dry, then manually turned over to allow coating to be applied to the other side. Once both sides were painted, the products were removed from the racks and stacked for bundling. Total time for this process was one to three hours.

E&J had looked at several alternatives for replacing their coating processes, including waterborne and powder coatings, but found that none provided all the properties necessary to significantly decrease or totally eliminate emissions, reduce finishing time, and improve quality.

### The New Way

E&J now uses a vacuum coating system to apply the finish, and ultraviolet (UV) vacuum energy for curing the coating. The new line is conveyorized and consists of coating application and recovery equipment, followed by a curing chamber that contains high-pressure mercury vapor UV lamps. The line runs at 60 ft/min (18 m/min) and products are automatically coated and cured in a matter of seconds.

Dowels are placed in a hopper and automatically fed to a conveyor that moves them to a coating chamber. They enter the coating chamber from the end of the conveyor, and are supported by a roller within the chamber while they are being coated. After the coating is applied, the dowels enter a vacuum chamber through an orifice that matches the profile of the



E&J uses a vacuum coating and UV curing system that has enabled the plant to cut emissions and increase quality.

dowel. The vacuum removes any excess coating and returns it to the coating supply reservoir. The thickness of the coating is controlled by the amount of vacuum that is applied and the speed of the conveyor. The dowels exit the vacuum chamber through an identical orifice and enter the curing chamber where they are immediately exposed to UV light to cure the coating. A second conveyor transports the parts to a hopper at the end of the system where they are bundled and readied for shipment.

### The Results: E&J Meets Its Goals

The UV coating material and vacuum coating/UV curing system has enabled E&J to substantially reduce VOC emissions, eliminate HAPs, improve the environment of the workplace, and increase the quality of its products.

### Reduced Emissions

The UV coatings used by E&J contain no solvents and consist of 100% solids. Viscosity of the coating is controlled through the use of monomers, which crosslink with the oligomers and polymers in the coating to form a solid cured film. Heating the coating in a reservoir also controls

viscosity of the applied coating. Due to the minimal use of solvents, E&J was able to reduce its emissions by 99% and become totally compliant with both federal and local air quality regulations. In addition, any over-sprayed and vacuum-removed coating is returned to the supply reservoir, making solid waste almost non-existent. Additionally, any materials that must be disposed of, such as purged material and cleaning rags, are simply exposed to UV light and cured. Therefore, it is not necessary to use special disposal sites for any liquid materials.

### A Safer and Cleaner Workplace

Due to the hazardous nature of the solvents used in nitrocellulose lacquers, their application requires the use of special storage conditions and explosion-proof equipment. Substantial ventilation is needed to exhaust solvents from the workplace to prevent a hazardous build-up and to protect workers' health. Humidity must also be controlled when applying lacquers, to ensure adequate drying and prevent blushing of the coating.

Use of vacuum coating and UV curing has eliminated the need to ventilate the workplace since the coater is self-contained and no solvents are emitted into the work environment. The air required for the vacuum operation is drawn from the plant, filtered, and exhausted to the atmosphere. Any modicum of latent moisture (humidity) from the vacuum air is dissipated through the relatively small amount of IR generated by the UV lamps.

### Improved Product Quality

Lacquers are not generally resistant to a wide variety of common chemicals. They are however, very brittle, which causes them to chip and abrade easily. Fluctuations in plant temperature and humidity

can cause the appearance of a lacquer finish to vary considerably from day to day. And, because the coating is air-dried, surface defects from airborne contaminants can result in rejected parts that must be sanded and recoated.

UV curable coatings, on the other hand, are thermoset materials that exhibit very good chemical resistance and result in flexible coatings that minimize chipping and damage from shipping and handling. Since humidity is not a significant variable in vacuum-applied UV curable coatings, appearance quality is more consistent. The almost instantaneous curing prevents airborne contamination of the coating, which results in fewer rejects. These features, along with a more consistent film thickness due to the automated process, resulted in an overall increase in the quality of the products E&J manufactures.

### What Did It Cost?

The new system allows virtually all of the coating to be used, and, because the UV coating is close to 100% solids, there is negligible loss due to solvent evaporation. E&J reports that their coating material costs were reduced by 61% (from \$.04125 per piece to \$.016 per piece) after installing the vacuum coating and UV curing equipment, which ran about \$35,000 for used equipment. The reduced material costs, along with the energy savings realized from reduced exhausts and fewer rejects, will provide rapid payback of the investment.

### The Bottom Line

The use of vacuum coating and UV curable coatings have allowed E&J to reduce emissions, increase quality, improve the environment of the workplace, and reduce overall costs. The dramatic reduc-



**Ed Kossar (right), president and CEO of E&J Industries, and Steve Blabac, New York State Electric and Gas, work together to meet NYSEG's goals.**

tion of VOCs and the elimination of HAPs have improved air quality for both the community and the plant. The increase in quality will allow E&J to pursue new business, and the reduction in operating costs will improve overall profitability of the company.

### Assistance from Local Utility

With the assistance of Steve Blabac of New York State Electric and Gas (NYSEG), E&J was able to identify a coating and curing process that would enable them to meet all their goals. Steve worked with the EPRI Center for Materials Fabrication to locate equipment and for technical support.

### Other Applications for UV Coatings

UV coating technology produces a tough, durable finish on a wide variety of coated and printed products, including wood furniture, electronic components, electric motors, tubing, plastic cups, and printed labels and tags. UV curable coatings in both liquid and powder form are available for application to wood, plastic, metal, paper, glass, and ceramic substrates.

Photographs courtesy of E&J Industries.

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